Notice No. 6

Rules and Regulations for the Classification of Ships, July 2014

The status of this Rule set is amended as shown and is now to be read in conjunction with this and prior Notices. Any corrigenda included in the Notice are effective immediately.

Issue date: December 2014

Amendments to	Effective date
Part 1, Chapter 2, Section 3	1 January 2015
Part 1, Chapter 3, Sections 1, 2, 3,11, 13 & 18	1 January 2015
Part 1, Chapter 3, Sections 6 & 7	CORRIGENDA
Part 1, Chapter 3, Section 23 (New)	1 January 2015
Part 5, Chapter 2, Section 7	1 January 2015
Part 5, Chapter 5, Section 3	1 January 2015
Part 5, Chapter 6, Section 3	1 January 2015
Part 5, Chapter 12, Sections 1, 2, 9 & 10	1 January 2015
Part 5, Chapter 13, Section 12	1 January 2015
Part 5, Chapter 14, Sections 3, 8 & 9	1 January 2015
Part 5, Chapter, Chapter 25 (New)	1 January 2015
Part 7, Chapter 3, Section 3	1 January 2015

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Part 1, Chapter 2

Classification Regulations

Effective date 1 January 2015

■ *Section 3*
Surveys – General

3.2 New construction surveys

3.2.1 When it is intended to build a ship for classification with LR, constructional plans and all necessary particulars relevant to the hull, equipment and machinery, as detailed in the Rules, are to be submitted for approval before the work is commenced. Proposals for ~~A~~any subsequent modifications or additions to the scantlings, arrangements or equipment shown on the approved plans are also to be submitted in writing and on plans for approval.

3.6 Surveys for novel/complex systems, machinery and equipment

3.6.1 Where novel/complex systems, machinery and equipment have been accepted by LR and for which existing survey requirements are not considered to be suitable and sufficient then appropriate survey requirements are to be derived as part of the design approval process. In deriving these requirements LR will consider, but not be limited to, the following:

(a) Plan appraisal submissions;
(b) Risk Assessment documentation where required by the Rules;
(c) Equipment manufacturer recommendations;
(d) Relevant recognised national or international standards.

Existing sub-Sections 3.6 *to* 3.11 *have been renumbered* 3.7 *to* 3.12.

Part 1, Chapter 3

Periodical Survey Regulations

Effective date 1 January 2015

■ *Section 1*
General

1.5 Definitions

1.5.28 A **natural gas fuel installation** comprises the following: fuel bunkering, fuel storage, fuel processing and fuel delivery to gas-fuelled consumers. The scope of the natural gas fuel installation extends from the bunker manifold to the natural gas-fuelled consumer and includes any re-liquefaction plant and compressors that are fitted to manage boil off. These installations may be on board any ship type referred to in this Chapter except gas carriers as defined in 1.5.7.

1.6 Preparation for survey and means of access

1.6.12 For **natural gas fuel installations** *see also* Section 23.1.

■ *Section 2*
Annual Surveys – Hull and Machinery requirements

2.2 Annual Surveys

2.2.42 For **natural gas fuel installations** *see also* Sections 23.3 to 23.6.

■ *Section 3*
Intermediate Surveys – Hull and Machinery Surveys

3.2 Intermediate Surveys

3.2.22 For **natural gas fuel installations** *see also* Section 23.7.

Corrigendum

■ *Section 6*
Special Survey – Bulk carriers – Hull requirements

6.7 Thickness measurement

6.7.1 The minimum requirements for thickness measurements are given in Table 3.6.4, *see also* 5.6. For ships built in accordance with the IACS Common Structural Rules (CSR), ~~the number and locations of measurements are detailed in the LR document *Thickness Measurement and Close-Up Survey Guidance*~~ refer to the LR document *Thickness Measurement and Close-Up Survey Guidance*.

Corrigendum

■ *Section 7*
Special Survey – Oil tankers (including ore/oil ships and ore/bulk/oil ships) – Hull requirements

7.7 Thickness measurement

7.7.1 The minimum requirements for thickness measurements are given in Table 3.7.6 (Single and double hull oil tankers, including ore/oil ships and ore/bulk/oil ships), *see also* 5.6. For ships built in accordance with the IACS Common Structural Rules (CSR), ~~the number and locations of measurements are detailed in the LR document *Thickness Measurement and Close-Up Survey Guidance*~~ refer to the LR document *Thickness Measurement and Close-Up Survey Guidance*.

Effective date 1 January 2015

■ *Section 11*
Machinery Surveys – General Requirements

11.2 Complete Surveys

11.2.12 For **natural gas fuel installations** *see also* Sections 23.8 and 23.9.

■ *Section 13*
~~Oil~~ Reciprocating internal combustion engines – Detailed requirements

Scope

The requirements of this Section are applicable to reciprocating internal combustion engines, operating on liquid, gas or dual fuel, providing power for services essential to the safety of the vessel.

■ *Section 18*
Inert gas systems

18.2 Scope of surveys

18.2.4 *See* 9.7.~~11~~12 for inert gas systems on ships for liquefied gases.

18.2.5 *See* 23.2.5 and 23.7.12 for inert gas systems on ships with natural gas fuel installations.

■ *Section 23*

Natural gas fuel installations

23.1 General

23.1.1 The requirements of Pt 1, Ch 3, 11 *Machinery surveys – General requirements* are to be complied with, as applicable.

23.1.2 In addition to the survey requirements below, further survey requirements may be imposed, as identified during the risk assessment process, *see* Pt 1, Ch 2, 3.6.

23.1.3 This Section provides requirements for the survey of natural gas fuel installations as defined in 1.5.28 (natural gas is hereinafter referred to as fuel).

23.1.4 The fuel installation is to be surveyed in working condition except at special survey where internal examination of some components will be required. *See* 23.8 and 23.9.

23.1.5 The Annual Survey should be scheduled, if possible, to coincide with a bunkering operation to allow for verification of fuel storage tank level alarms and bunkering control, alert and safety systems under operational conditions. At annual survey physical testing of alarms and shutdowns is not required unless it is considered necessary by the attending Surveyor. In any case records of the alarms are to be retained for the verification of the attending Surveyor.

23.1.6 The Intermediate Survey supplements the Annual Survey by testing the fuel bunkering system including automatic control, alert and safety systems to confirm satisfactory operation. The extent of the testing required for the Intermediate Survey may briefly interrupt the fuel installation and therefore vessel operations and the survey are to be scheduled accordingly.

23.1.7 The extent of the testing required for Complete Surveys will normally be such that the full survey cannot be carried out with the fuel installation operating or loaded with fuel. Consequently, aspects of the survey should be coordinated to correspond with dry-docking or another period when the system will be gas free. Completion of the survey requires verification of satisfactory condition of the installation at the normal operating temperatures and pressures so will normally be completed once the vessel has been bunkered following reactivation of the system.

23.1.8 Prior to any internal inspection of fuel storage tanks, associated piping, fittings and equipment, etc., the respective items are to be made safe for access by means of isolating relevant valves, purging and gas-freeing the space.

23.1.9 Where an approved condition-monitoring system is employed for the fuel system and its constituent components, and the applicable Descriptive Note is assigned, the requirements of these regulations for opening up and internal examination may be waived where the condition of the equipment can be shown to be within agreed acceptable limits as detailed in Pt 5, Ch 21.

23.1.10 The following documentation, as applicable, is to be available on board the ship:

(a) Relevant instruction and information such as loading limit curve information, bunkering procedures, cooling down procedures and fuel installation test and inspection procedures.
(b) Condition-Monitoring or Condition-Based Maintenance documentation as applicable.
(c) Test records for bunkering ESD systems
(d) Records of crew tests/inspections of the fuel installation

23.1.11 For Special Survey requirements for electrical equipment *see* Section 14.

23.1.12 Where the design of any part of the natural gas fuel system does not permit opening up for internal examination, as required by these regulations, alternative arrangements for testing and/or inspection will be specially considered.

23.2 Survey Following Repair

23.2.1 Following repair, independent fuel storage tanks of Type C are to be hydrostatically tested in accordance with the manufacturer's test and inspection instructions (normally at 1,25 times the approved maximum vapour pressure). Other types of fuel storage tank, such as membrane tanks, are to be tested in accordance with approved procedures provided by the fuel storage tank designers. After testing, suitable drying and consequent air-purging procedures are to be followed to return the tank to operational condition.

23.3 Annual Surveys − General requirements for fuel systems

23.3.1 The Annual Survey is to be carried out with the fuel installation operational. Gas-freeing will not generally be necessary.

23.3.2 The ship's log and operational records for the fuel installation, covering the period from the previous survey, are to be examined. Any malfunction of the installation recorded in the log is to be investigated. It is to be verified that any repairs have been carried out to an acceptable standard and in accordance with the applicable Rules and Regulations.

23.3.3 Control, alert and safety systems are to be surveyed as follows:

(a) The control, alert and safety systems for the fuel storage tanks and processing system are to be verified in satisfactory condition by one or more of the following methods:
  (i) Comparison of read-outs from local and remote indicators.
  (ii) Consideration of read-outs with regard to the actual conditions.
  (iii) Examination of maintenance records with reference to the approved maintenance management system.
  (iv) Verification of calibration status of the measuring instruments.

(b) All control, alerts and safety systems are to be tested, where testing is not possible due to operational reasons simulated testing may be accepted by the attending Surveyor. Which are to include but are not limited to:
  (i) fuel storage tank and processing system high and low pressure.
  (ii) fuel storage tank high and high-high level
  (iii) fuel storage tank overfill level
  (iv) fuel storage tank high temperature.

(c) Fuel leakage detection systems (temperature sensors and gas detection as applicable) are to be examined and tested in accordance with the manufacturer's instructions and calibrated using sample gas.

(d) The electrical installation, equipment and cables in areas which may contain flammable gas are to be examined in order to verify that they are in good condition and have been properly maintained. Bonding straps that are installed to control static electricity are to be visually examined.

(e) Alerts and safety systems associated with pressurised installations and any safety device associated with non-safe type electrical equipment that is protected by air-locks or pressurisation, are to be verified.

23.3.4 Fuel installations are to be surveyed as follows:

(a) Portable and/or fixed drip trays, or insulation providing protection in the event of fuel leakage, are to be examined.

(b) Components of the fuel installation fitted with insulation to provide protection against ice formation are to be examined for satisfactory condition.

(c) Fuel piping, valves and fittings are to be generally examined, with particular attention to double-wall or ventilated ducting arrangements, expansion bellows, supports and vapour seals on insulated piping.

23.3.5 Inerting arrangements and associated alarms are to be verified as being in satisfactory condition, including the means for prevention of backflow of fuel vapour to the inert gas system.

23.3.6 Ventilation systems are to be surveyed as follows:

(a) Ventilation systems and air-locks including their alarm system are to be generally examined.

(b) Ventilation fans in hazardous areas are to be visually examined.

(c) For ventilated double-walled piping or ducting containing fuel piping within machinery spaces, exhaust fans and/or supply fans are to be examined to ensure that the air-flow is not impeded.

(d) Fuel piping and components associated with the fuel processing equipment are to be visually examined.

23.3.7 The closing devices for all air-intakes and openings into accommodation spaces, service spaces, machinery spaces, control stations and approved openings in superstructures and deckhouses less than 10m from deck-mounted fuel storage tanks, are to be examined.

23.3.8 Venting arrangements, including protection screens if provided, for fuel storage tanks, inter-barrier spaces and tank hold spaces as applicable, are to be visually examined externally. The external condition of the fuel storage tank relief valves is to be verified and records of the last test of the opening/closing pressures are to be reviewed.

23.3.9 Means for draining the vent arrangements from fuel storage tank pressure relief valves and other system relief valves are to be examined to ensure that there is no liquid build-up that would impede effective operation, drain valves are to be checked as applicable.

23.3.10 Heating arrangements, if fitted, for steel structures in cofferdams and other spaces are to be verified in satisfactory condition.

23.3.11 All gas-tight bulkhead penetrations, including any gas-tight shaft seals, are to be visually examined.

23.4 Annual Surveys – fuel processing equipment

23.4.1 The following fuel processing equipment is to be generally examined in working condition and operational parameters verified. Insulation, where fitted, need not be removed but any deterioration of insulation, or evidence of dampness which could lead to external corrosion of the vessels or their connections, is to be investigated:

(a) Heat exchangers and pressure vessels.

(b) Natural gas fuel heaters, vaporisers, masthead heaters.

(c) Heating arrangements, including provision for continuous heating and circulation of heating medium to prevent freezing during start up and when the fuel installation is not in use.

(d) Fuel piping and components associated with the fuel processing equipment.

23.4.2 Where the double wall or duct containing fuel piping is protected using a pressurised inert gas atmosphere the monitoring and maintenance of the inert atmosphere is to be confirmed in satisfactory condition.

23.4.3 The condition of the fuel isolation valve and double block and bleed arrangements for each consumer is to be examined with respect to:

(a) Containment to prevent fuel leakage from any valve arrangements installed within the machinery space.

(b) Connections to the inerting and venting arrangements.

(c) General examination to confirm that the valve arrangement and all associated fuel monitoring and control equipment are in satisfactory condition. The external examination is to be supplemented by a review of relevant operational, maintenance and service reports.

23.4.4 Where fuel processing equipment is located within an independent space that functions as containment in the event of a fuel spill (e.g. a tank connection space), the space is to be examined internally and externally to verify that the structure remains in a satisfactory condition to contain any potential leakage of fuel including any thermal isolation to protect the surrounding structure from damage due to cryogenic leakage.

23.4.5 Records of testing the operation of the tank master isolation valve are to be verified. Tests are to be carried out on a regular basis as agreed with LR and the scope of the testing should incorporate a full test of the Emergency Shutdown sequence. Where possible, operation of the valve as described above is to be witnessed at the time of survey.

23.5 Annual Surveys – fuel storage

23.5.1 Areas in which fuel storage tanks are located (on and below deck) are to be examined for any changes to the arrangements within those areas that may affect the hazardous area rating.

23.5.2 For Type C pressurised fuel storage tanks the external surface of the fuel storage tank insulation is to be visually examined for cold spots to verify the condition of the insulation arrangements. This examination is to be carried out with the fuel storage tanks loaded. Ideally fuel storage tanks should be loaded to the maximum loading limit; examination of partially-filled fuel storage tanks may be accepted alongside a review of records of periodic cold spot examinations carried out by suitably trained and qualified crew.

23.5.3 The supporting structure between the deck plating and the tank is to be examined to confirm that the saddle arrangement remains in satisfactory condition in accordance with the approved design.

23.5.4 For vacuum-insulated fuel storage tanks, monitoring records are to be reviewed to confirm satisfactory maintenance of the vacuum. Any trends identifying a breakdown or loss of vacuum containment are to be investigated.

23.5.5 For Type B fuel storage tanks where the insulation arrangements are such that the insulation cannot be examined, the surrounding structures of wing tanks, double bottom tanks and cofferdams are to be visually examined for cold spots. This examination is to be carried out with the fuel storage tanks loaded. Ideally fuel storage tanks should be loaded to the maximum loading limit; examination of partially-filled fuel storage tanks may be accepted alongside a review of records of periodic cold spot examinations carried out by suitable trained and qualified crew.

23.5.6 For membrane fuel storage tanks the performance of the insulation arrangements is to be confirmed in accordance with approved procedures submitted by the containment designers.

23.6 Annual Survey – fuel bunkering system

23.6.1 The fuel bunkering system, including manifold connections, isolation valves, bunker piping and linked Emergency Shut Down (ESD) system connection equipment (including cabling and connectors), are to be visually examined.

23.6.2 Bunkering operations are to be observed as far as possible; satisfactory condition of the bunkering control, alert and safety system is to be verified. During Annual Survey it is not expected that ESD1 (stoppage of bunker transfer) or ESD2 (disconnection of bunker piping) will be operationally tested but records of maintenance and testing are to be reviewed. However, prior to starting the bunkering operation, it is expected that an ESD1 is tested with no LNG in the system (i.e. a dry test). Records of the testing are to be available during survey.

23.7 Intermediate Surveys

23.7.1 The requirements of 23.1 to 23.6 are to be complied with.

(a) Control, alert and safety systems for the bunkering system, fuel-containment systems and processing equipment, together with any associated shutdown and/or interlock, are to be tested under working conditions and, if necessary, recalibrated. Shutdown sequence and extent are to be verified against documented procedures where applicable. Such safety systems include but are not limited to:

  (i) Bunkering ESD system is to be tested, without fuel in the piping, to verify that ESD system operation will result in a closure of the isolation valves and a shutdown of machinery associated with bunkering operations. All ESD activations and outputs are to be tested including fuel storage tank overfill protection, bunkering isolation valve closure and automatic shutdown of machinery associated with bunkering operations.

(ii) Fuel-processing equipment shutdown and closure of isolation valves resulting from:
- loss of the valve-actuating medium;
- loss of ventilation in fuel piping double wall /ventilated duct; or
- loss of pressure of inert gas in pressurised double-walled pipe arrangement.

(iii) Fuel processing equipment shutdown and closure of isolation valves as a result of deviation in the fuel supply to the engine-room from the normal operating conditions (temperature and pressure).

(iv) Fuel installation shutdown as a result of gas detection.

(v) Safety interlocks on fuel-processing equipment are to be examined and tested as necessary to confirm satisfactory condition.

(b) A General Examination within the areas deemed as hazardous, such as bunker stations, vent mast area, tank connection space and spaces adjacent to vent arrangements from the tank connection space (if applicable), to verify the electrical arrangements have been maintained satisfactorily for operation in a hazardous environment.

(c) Verification that piping and independent fuel storage tanks are electrically bonded to the hull.

23.7.2 Consideration will be given to simulated testing, provided that it is considered representative. Comprehensive maintenance records, including details of tests carried out in accordance with the fuel plant and instrumentation maintenance manuals may be presented for review. Acceptance of either simulated testing or maintenance records including reports of testing as described above is subject to the satisfaction of the attending Surveyor.

23.8 Complete Surveys – general requirements

23.8.1 The requirements of 23.1 to 23.7 are to be complied with.

23.8.2 The items covered by 23.8.3 to 23.9.5 may, at the request of the Owner, be examined on a Continuous Survey basis provided that the interval between examinations of each item does not exceed five years. Exceptions may be made to this requirement if Condition Based Maintenance arrangements have been agreed and maintained satisfactorily (*see* 23.1.9).

23.8.3 Except where alternative provisions are given in 23.8.6 and 23.8.7 below, all fuel storage tanks are to be examined externally and internally, particular attention being paid to the plating in way of supports of securing arrangements for independent tanks, pipe connections, also to sealing arrangements in way of the deck penetrations. Insulation is to be removed as required.

23.8.4 Provided that the structural examination is satisfactory, that the gas detection systems have been found to be in satisfactory condition, routine on board checks and maintenance records are satisfactory and that the voyage records have not shown any abnormal operation, fuel storage tanks will not require hydrostatic testing (except as required by 23.8.6.(d).(i)).

23.8.5 The non-destructive testing (NDT) of independent fuel storage tanks is to supplement visual inspection with particular attention to be given to the integrity of the main structural members, tank shell and highly-stressed parts, including welded connections as deemed necessary by the Surveyor. The following items are considered as highly-stressed parts:
- structure in way of tank supports and anti-rolling/anti-pitching devices,
- web frames or stiffening rings,
- swash bulkhead boundaries,
- dome and sump connections to tank shell,
- foundations for pumps, towers, ladders, etc.,
- pipe connections.

23.8.6 The NDT testing requirements for different types of independent fuel storage tanks are detailed below; where radiographic or ultrasonic testing is required, at least 10 per cent of the length of the applicable welded connections is to be tested. This testing is to be carried out internally and externally as applicable. Insulation is to be removed as necessary for the required non-destructive testing:

(a) For independent fuel storage tanks of Type B, the extent of non-destructive testing is to be given in the test schedule specially prepared for the tank design. The Owner is to submit proposals for the extent of non-destructive testing of the fuel storage tanks in advance of the survey.

(b) For vacuum-insulated independent fuel storage tanks of Type C vacuum monitoring is accepted as a demonstration of the internal integrity of the tank. This is subject to verification that the monitoring equipment is being maintained, operated and calibrated in a satisfactory condition. There is no further requirement for internal examination and testing of these tanks. The tank support arrangements are to be visually examined; non-destructive testing may be required if the condition raises doubt as to the structural integrity.

(c) For non-vacuum insulated independent fuel storage tanks of Type C non-destructive testing is required on the plating in way of supports and also over selected lengths of welds. Where such testing raises doubt as to the structural integrity, further testing is to be carried out in accordance with the requirements of the manufacturer's test and inspection instructions for hydraulic testing (normally at 1,25 times the approved maximum vapour pressure). Alternatively, consideration will be given to pneumatic testing under special circumstances, provided full details are submitted for approval.

(d) At each alternate Complete Survey (i.e. at 10 year intervals); non-vacuum insulated independent fuel storage tanks of Type C are to be either:

(i) Hydrostatically or hydro-pneumatically tested to not less than 1,25 times MARVS in accordance with the requirements of the manufacturer's test and inspection instructions. The requirements for non-destructive testing in 23.8.5 are to be carried out following this test as required by the Surveyor; or

(ii) Subject to a thorough, planned, non-destructive testing. This testing is to be carried out in accordance with a test schedule specially prepared for the tank design. If a special programme does not exist, the following should be tested:

- structure in way of tank supports and anti-rolling/anti-pitching devices;
- stiffening rings;
- Y-connections between tank shell and a longitudinal bulkhead of bi-lobe tanks;
- swash bulkhead boundaries if applicable;
- dome and sump connections to the tank shell if applicable;
- pipe connections.

23.8.7 Membrane fuel storage tank surveys are to be carried out in accordance with approved testing procedures provided by the containment designers.

23.8.8 Fuel storage tank pipe connections and fittings are to be examined, and all valves and cocks in direct communication with the interiors of the tanks are to be opened out for inspection and the connection pipes are to be examined internally, so far as practicable. Special attention is to be paid to the fuel storage tank master isolation valve(s); the valve seat is to be visually examined and the valve tested at the maximum working pressure of the fuel storage tank prior to re-commissioning the fuel system.

23.8.9 Relief valves are to be surveyed as follows:

(a) The pressure relief valves for the fuel storage tanks are to be opened for examination, adjusted to the correct operating pressure as indicated in 23.8.9(b), function-tested, and sealed. If the tanks are equipped with relief valves with non-metallic membranes in the main or pilot valves, such non-metallic membranes are to be replaced. Valves may be removed from the tank for the purpose of making this adjustment under pressure of air or other suitable gas. If valves are removed, the tank and fuel piping downstream of the tank isolation valves are to be gas-freed and inerted.

(b) Valves are to lift at a pressure not more than the percentage given below, above the maximum vapour pressure for which the tanks have been approved:
For 0 to 1,5 bar, 10 per cent.
For 1,5 to 3,0 bar, 6 per cent.
For pressures exceeding 3,0 bar, 3 per cent.

(c) Where a detailed record of continuous overhaul and retesting of individually-identifiable relief valves is maintained, consideration will be given to acceptance on the basis of opening, internal examination, and testing of a representative sampling of valves, including each size and type of relief valve in use, provided there is logbook evidence that the remaining valves have been overhauled and tested since the previous Complete Survey.

(d) Relief valves on fuel piping are to have their pressure settings checked. The valves may be removed from the piping for this purpose. At the Surveyor's discretion a sample of each size and type of valve may be opened for examination and testing.

23.8.10 All fuel pumps, booster pumps and vapour pumps are to be opened out for examination. Where applicable, pumping systems for inter-barrier spaces are to be checked and verified to be in satisfactory condition.

23.8.11 Piping for the fuel processing system including valves, actuators and compensators is to be opened for examination. Insulation may need to be removed, as deemed necessary, to ascertain the condition of the piping. If any doubt exists regarding the integrity of the piping based upon visual examination then, where deemed necessary by the Surveyor, a pressure test at 1,25 times MARVS of the piping is to be carried out. The complete piping systems are to be tested for leaks after re-assembly.

23.8.12 Equipment for the production of inert gas is to be examined and shown to be in satisfactory condition, operating within the gas specification limits. Piping, valves, etc., for the distribution of the inert gas are to be generally examined. Pressure vessels for the storage of inert gas are to be examined internally and externally and the securing arrangements are to be specially examined. Pressure relief valves are to be demonstrated to be in satisfactory condition. Liquid nitrogen storage vessels are to be examined, so far as practicable, and all control equipment, alarms and safety devices are to be verified as operational.

23.8.13 Gastight bulkhead shaft seals are to be opened out so that the sealing arrangements may be checked.

23.8.14 Any sea connections associated with the fuel handling equipment are to be opened out when the ship is in dry dock.

23.8.15 Where an approved condition-monitoring system or condition-based maintenance system is in place, the requirements for opening up of equipment may be reduced accordingly where the condition of the equipment can be shown to be within agreed acceptable limits as detailed in Pt 5, Ch 21.

23.8.16 Testing of the tank connection space and cofferdam leakage-detection arrangement (temperature sensors and gas detectors) is to be carried out.

23.8.17 An electrical insulation resistance test of the circuits terminating in, or passing through, hazardous areas, is to be carried out. If the ship is not in a gas-free condition, the results of previously recorded test readings may be accepted together with a review of the on-board monitoring of the earth loop impedance of relevant circuits.

23.9 Complete Surveys – natural gas-fuelled consumers and other equipment

23.9.1 Heat exchangers associated with the fuel installation are to be opened out and examined as follows:

(a) The water end covers of evaporators are to be removed for examination of the tubes, tube plates and covers.

(b) Heating medium pumps, including standby pump(s) which may be used on other services, are to be opened out for examination.

(c) Where a pressure vessel is insulated, sufficient insulation is to be removed, especially in way of connections and supports, to enable the vessel's condition to be ascertained.

NOTE

This refers to external insulation, not additional insulation that may be installed in the annular space of a vacuum insulated tank.

(d) Insulated piping is to have sufficient insulation removed to enable its condition to be ascertained. Vapour seals are to be specially examined for their condition. Vacuum-insulated piping is to be visually examined and records of maintenance and vacuum monitoring are to be reviewed.

23.9.2 The steam side of steam heaters is to be hydraulically tested to 1,5 times the design pressure.

23.9.3 Fuel pipe ducts or casings are to be generally examined and the exhaust or inerting arrangements are to be verified.

23.9.4 All alarms associated with the natural gas burning systems are to be verified; including, but not limited to, main and auxiliary engines, boilers, incinerators and gas combustion units.

23.9.5 The satisfactory condition of all pressure relief valves and/or safety discs throughout the installation is to be verified.

Part 5, Chapter 2

~~Oil~~ Reciprocating Internal Combustion Engines

Effective date 1 January 2015

■ *Section 7*
Control and monitoring of main, auxiliary and emergency ~~diesel~~ engines

7.1 General

(*Part only shown*)
7.1.2 Oil mist detection, or engine bearing temperature monitors or alternative methods for crankcase protection are to be provided:
NOTES
1. For ~~medium and high speed~~ trunk piston engines, automatic shutdown of the engine is to occur.
2. For ~~slow speed~~ crosshead engines, automatic slow-down is to occur.

7.6 ~~Oil e~~Engines for propulsion purposes

(*Part only shown*)
Table 2.7.1 (a) ~~Oil engines~~ Engines for propulsion purposes: Alarms and slow-downs

Item	Alarm	Note
~~Oil mist concentration in crankcase or bearing temperature~~	~~High~~	~~Automatic slow-down of slow speed engines, *see* 7.1.2. One sensor per lubricator unit. Slow-down (automatic on medium and high speed engines)~~
~~Cylinder lubricator flow~~	~~Low~~	
Oil mist concentration in crankcase or bearing temperature	High	*See* 7.1.2. Automatic slow-down of crosshead engines, for trunk piston engines *see* Table 2.7.1(b)
Cylinder lubricator flow	Low	One sensor per lubricator unit on crosshead engines. Slow down.
Cylinder coolant inlet pressure or flow*	Low	Slow-down (automatic on ~~medium and high speed~~ trunk piston engines)
Cylinder coolant outlet temperature*	1st stage high	Per cylinder (if a separate system). Slow-down (automatic on ~~medium and high speed~~ trunk piston engines)
Charge air cooler outlet temperature	High ~~and Low~~	~~4-stoke medium and high speed~~ Trunk piston engines
Exhaust gas temperature*	High	Per cylinder. Slow-down (automatic on ~~medium and high speed~~ trunk piston engines), *see* Note 5
~~Turbo-charger~~ Turbocharger exhaust gas inlet temperature	High	Each ~~turbo-charger *See*~~ turbocharger, *see* Note 6
~~Turbo-charger~~ Turbocharger exhaust gas outlet temperature*	High	Each ~~turbo-charger~~ turbocharger
~~Turbo-charger~~ Turbocharger lubricating oil inlet pressure	Low	~~If system not integral with turbo-charger~~ *See* Note 10
~~Turbo-charger~~ Turbocharger lubricating oil outlet temperature	High	Each bearing, if system not integral with ~~turbo-charger~~ turbocharger. *See* Notes 7 and 10

NOTES
1. Where 'per cylinder' appears in this Table, suitable sensors may be situated on manifold outlets for ~~medium and high speed engines~~ trunk piston engines.
5. For ~~medium and high speed~~ trunk piston engine power <500 kW/cylinder, a common sensor for exhaust gas manifold temperature may be fitted.
6. ~~May be combined with exhaust gas outlet temperature high alarm where the turbo-charger is mounted directly on the exhaust manifold~~ Alarm and indication of the exhaust gas temperature at turbocharger inlet may be waived if alarm and indication for individual exhaust gas temperature is provided for each cylinder and the alarm level is set to a value specified by the turbocharger manufacturer.
10. Separate sensors are to be provided if the lubrication oil system of the turbocharger is not integrated with the lubrication oil system of the engine or if it is separated by a throttle or pressure reduction valve from the engine lubrication oil system. Where the turbocharger is provided with a self-contained lubricating oil system integrated with the turbocharger, lubricating oil inlet pressure need not be monitored.

Table 2.7.1(b) ~~Oil engines~~ Engines for propulsion purposes: ~~Alarms and slow-downs~~ Automatic shutdowns

Item	Alarm	Note
Lubricating oil inlet pressure	2nd stage low	Automatic ~~shut-down~~ shutdown of engines, *see* 7.5.4
Oil mist concentration in crankcase or bearing temperature	High	*See* 7.1.2. Automatic ~~shut-down~~ shutdown of ~~medium and high speed~~ trunk piston engines, ~~see 7.1.2~~ for crosshead engines, *see* Table 2.7.1(a)
Cylinder coolant outlet temperature	2nd stage high	Automatic ~~shut-down~~ shutdown of ~~medium and high speed~~ trunk piston engines, *see* 7.5.4
Overspeed	High	Automatic ~~shut-down~~ shutdown of engine, *see also* 7.4. Details of alternative proposals in accordance with the manufacturer~~er~~'s instructions may be submitted for consideration

(*Part only shown*)

Table 2.7.2 Auxiliary engines: Alarms and safeguards

Item	Alarm	Note
Uptake temperature	High	To monitor for soot fires. *See* Notes 3 and 4
Turbocharger lubricating oil outlet temperature	High	Each bearing, *see* Note 5
Turbocharger lubrication oil inlet pressure	Low	*See* Note 6

NOTES

5. Unless provided with a self-contained lubricating oil system integrated with the turbocharger.
6. Where outlet temperature from each bearing cannot be monitored due to the engine/turbocharger design alternative arrangements may be accepted. Continuous monitoring of inlet pressure and inlet temperature in combination with specific intervals for bearing inspection in accordance with the turbocharger manufacturer's instructions may be accepted as an alternative.

7.8 Emergency ~~diesel~~ engines

(*Part only shown*)

Table 2.7.3 Emergency ~~diesel~~ engines: Alarms and safeguards

Item	Alarm for engine power <220 kW	Alarm for engine power ~~≤~~≥220kW	Note

Part 5, Chapter 5

Gearing

Effective date 1 January 2015

■ *Section 3*
Design

3.1 Symbols

(*Part only shown*)

3.1.1 For the purposes of this Chapter the following symbols apply:

$S_{H\ min}$ = minimum factor of safety for Hertzian contact stress
S_R = rim thickness of gears, in mm
Y_B = rim thickness factor
Y_D = design factor
Y_{DT} = deep tooth factor
Y_F = tooth form factor
$Y_{R\ rel\ T}$ = relative surface finish factor
Y_S = stress ~~concentration~~ correction factor
Y_{ST} = stress correction factor (relevant to the dimensions of the standard reference test gears)

3.3 Tooth loading factors

3.3.2 Load sharing factor, K_γ. ~~The value for K_γ is to be taken as 1,15 for multi-engine drives or split torque arrangements. Otherwise K_γ is to be taken as 1,0. Alternatively, where measured data exists, a derived value will be considered.~~ When a gear drives two or more mating gears where the total transmitted load is not evenly distributed between the individual meshes, a factor, K_γ, is to be applied. K_γ is defined as the ratio between the maximum load through an actual path and the evenly shared load. This is to be determined by measurements. Where a value cannot be determined in such a way, the values in Table 5.3.2 may be considered:

Table 5.3.2 Values of K_γ

	K_γ
Spur Gear	1,0
Epicyclic Gears	
Up to 3 planetary gears	1,0
4 planetary gears	1,2
5 planetary gears	1,3
6 planetary gears and over	1,4

~~*3.3.3 Dynamic factor, K_v:*~~

~~For helical gears with $\varepsilon_\beta \geq 1$:~~

~~$K_v = 1 + Q^2 v z_1 10^{-5} = K_{v\beta}$~~

~~For helical gears with $\varepsilon_\beta \leq 1$:~~

~~$K_v = K_{v\alpha} - \varepsilon_\beta (K_{v\alpha} - K_{v\beta})$~~

~~For spur gears:~~

~~$K_v = 1 + 1.8\, Q^2 v z_1 10^{-5} = K_{v\alpha}$~~

~~where $\frac{vz_1}{100} > 14$ for helic gears, and~~

~~where $\frac{vz_1}{100} > 10$ for spur gears the value of K_v will be specially considered.~~

3.3.3 Dynamic factor, K_v, is to be calculated as follows when all the following conditions are satisfied:

$$\frac{vz_1}{100}\sqrt{\frac{u^2}{1+u^2}} < 10 \text{m/s}$$

- spur gears ($\beta = 0°$) and helical gears with $\beta \leq 30°$
- pinion with relatively low number of teeth, $z_1 < 50$
- solid disc wheels or heavy steel gear rim

Or this method may also be applied to all types of gears if:

$\frac{vz_1}{100}\sqrt{\frac{u^2}{1+u^2}} < 3m/s$

And to helical gears where $\beta > 30°$

1. For spur gears and for helical gears with $\varepsilon_\beta \geq 1$:

$$Kv = 1 + \left(\frac{K_1}{K_A \frac{F_t}{b}} + K_2\right)\frac{vz_1}{100} K_3 \sqrt{\frac{u^2}{1+u^2}}$$

where $K_A F_t/b$ is less than 100 N/mm, the value 100 N/mm is to be used.

Numerical values for the factor K_1 are to be as specified in the Table 5.3.3.

Table 5.3.3 Values of K_1

	K_1 ISO accuracy Grade					
	3	4	5	6	7	8
Spur Gears	2,1	3,9	7,5	14,9	26,8	39,1
Helical Gears	1,9	3,5	6,7	13,3	23,9	34,8

For all accuracy grades the factor K_2 is to be in accordance with the following:
- for spur gears $K_2 = 0,0193$
- for helical gears $K_2 = 0,0087$

Factor K_3 is to be in accordance with the following:

If $\frac{vz^1}{100}\sqrt{\frac{u^2}{1+u^2}} \leq 0,2$ then $K_3 = 2,071 - 0,357 \frac{vz_1}{100}\sqrt{\frac{u^2}{1+u^2}}$

If $\frac{vz^1}{100}\sqrt{\frac{u^2}{1+u^2}} > 0,2$ then $K_3 = 2,071 - 0,357 \frac{vz_1}{100}\sqrt{\frac{u^2}{1+u^2}}$

2. For helical gears with overlap ratio $\varepsilon_\beta < 1$, the value K_v is to be determined by linear interpolation between values determined for spur gears ($K_{v\alpha}$) and helical gears ($K_{v\beta}$) in accordance with:

$K_v = K_{v\alpha} - \varepsilon_\beta(K_{v\alpha} - K_{v\beta})$

$K_{v\alpha}$ is the K_v value for spur gears, in accordance with (a)

$K_{v\beta}$ is the K_v value for helical gears, in accordance with (b)

(*Part only shown*)

3.3.5 Transverse load distribution factors, $K_{H\alpha}$ and $K_{F\alpha}$

~~$K_{H\alpha} = K_{F\alpha} \geq 1,00$~~

~~where~~

(a) Values $K_{H\alpha}$ and $K_{F\alpha}$ for gears with total contact ratio $\varepsilon_\gamma \leq 2$

$$K_{H\alpha} = K_{F\alpha} = \frac{\varepsilon_\gamma}{2}\left\{0,9 + \frac{0,4C_\gamma(f_{pb} - y_\alpha)b}{F_t K_A K_\gamma K_v K_{H\beta}}\right\}$$

(b) Values $K_{H\alpha}$ and $K_{F\alpha}$ for gears with total contact ratio $\varepsilon_\gamma > 2$

$$K_{H\alpha} = K_{F\alpha} = 0,9 + 0,4\sqrt{\frac{2(\epsilon_\gamma - 1)}{\varepsilon_\gamma}}\left\{\frac{C_\gamma(f_{pb} - y_\alpha)b}{F_t K_A K_\gamma K_v K_{H\beta}}\right\}$$

Limiting conditions for $K_{H\alpha}$:

If $K_{H\alpha} \leq \frac{\varepsilon_\gamma}{\varepsilon_\alpha Z_\varepsilon^2}$ when calculated in accordance with (a) or (b), then $K_{H\alpha} = \frac{\varepsilon_\gamma}{\varepsilon_\alpha Z_\varepsilon^2}$

If $K_{H\alpha} < 1$ when calculated in accordance with (a) or (b), then $K_{H\alpha} = 1$

Limiting conditions for $K_{F\alpha}$:

If $K_{F\alpha} \not> \frac{\varepsilon_\gamma}{0,25\varepsilon_{\gamma\alpha} + 0,75}$ when calculated in accordance with (a) or (b), then $K_{F\alpha} = \frac{\varepsilon_\gamma}{0,25\varepsilon_{\gamma\alpha} + 0,75}$

If $K_{F\alpha} < 1$ when calculated in accordance with (a) or (b), then $K_{F\alpha} = 1$

(*Part only shown*)

3.4.1 The Hertzian contact stress, σ_H, at the pitch circle is not to exceed the allowable Hertzian contact stress, σ_{HP}.

where

$$Z_H = \sqrt{\frac{2\cos\beta_b \cos\alpha_{tw}}{\cos^2\alpha_t \sin\alpha_{tw} \tan\alpha_{tw}}}$$

Z_E = 189,8 for steel

Z_ε, contact ratio factor is to be calculated as follows:

for helical gears:

$$Z_\varepsilon = \sqrt{\frac{4-\varepsilon_\alpha}{3}\left(1-\varepsilon_\beta\right)+\frac{\varepsilon_\beta}{\varepsilon_a}} \qquad \text{for } \varepsilon_\beta < 1 \text{ and}$$

$$Z_\varepsilon = \sqrt{\frac{1}{\varepsilon_\alpha}} \qquad \text{for } \varepsilon_\beta \geq 1$$

for spur gears:

$$Z_\varepsilon = \sqrt{\frac{4-\varepsilon_\alpha}{3}}$$

~~$Z_\beta = \sqrt{\cos\beta}$~~

$$Z_\beta = \sqrt{\frac{1}{\cos\beta}}$$

~~$Z_R = \left(\frac{1}{R_a}\right)^{0.11}$ but $Z_R \leq 1{,}14$~~

$$Z_R = \left(\frac{3}{R_{Z10}}\right)^{C_{ZR}}$$

where

$$R_Z = \frac{R_{Z1} + R_{Z2}}{2}$$

~~Where R_a is the surface roughness value of the tooth flanks. When pinion and wheel tooth flanks differ then the larger value of R_a is to be taken.~~

The peak-to-valley roughness determined for the pinion R_{z1} and for the wheel R_{z2} are mean values for the peak-to-valley roughness R_z measured on several tooth flanks.

$$R_{Z10} = R_Z \sqrt[3]{\frac{10}{\rho_{red}}}$$

relative radius of curvature:

$$\rho_{red} = \frac{\rho_1 \cdot \rho_2}{\rho_1 + \rho_2}$$

where

$$\rho_{1,2} = 0{,}5 \cdot d_{b1,2} \cdot \tan\alpha_{tw}$$

For internal gears, d_b has a negative sign.

If R_a, the surface roughness of the tooth flanks is given then the following approximation may be applied:

$$R_a = \frac{R_Z}{6}$$

C_{ZR} is to be taken from Table 5.3.4.

$$Z_v = 0{,}88 + 0{,}23\left(0{,}8 + \frac{32}{v}\right)^{-0{,}5}$$

For values of Z_x, *see* Table 5.3.~~2~~5

$\sigma_{H\ lim}$, *see* Table 5.3.~~3~~6

$S_{H\ ~~lim~~\ min}$, *see* Table 5.3.~~4~~7

Table 5.3.4 Values of C_{ZR}

$\sigma_{H\,lim}$	C_{ZR}
σ_{Hlim} < 850 N/mm^2	0,1500
850 N/mm^2 ≤ $\sigma_{H\,lim}$ ≤ 1200 N/mm^2	= 0,32 – 0,0002 σ_{Hlim}
σ_{Hlim}>1200 N/mm^2	0,080

Tables 5.3.2 *to* 5.3.4 *have been renumbered* 5.3.5 *to* 5.3.7.

(*Part only shown*)

3.5.1 The bending stress at the tooth root, σ_F is not to exceed the allowable tooth root bending stress σ_{FP}

~~$\sigma_F = \frac{F_t}{b\,m_n} Y_F Y_S Y_\beta K_A K_V K_\gamma K_{F\beta} K_{F\alpha}$ N/mm²~~

$\sigma_F = \frac{F_t}{b\,m_n} Y_F Y_S Y_\beta Y_B Y_{DT} K_A K_\gamma K_V K_{F\alpha} K_{F\beta}$ N/mm²

For values of $S_{F\,min}$, *see* Table 5.3.~~4~~7

$\sigma_{F\,lim}$, *see* Table 5.3.~~5~~8

Table 5.3.5 *has been renumbered* 5.3.8.

~~*3.5.6 Relative notch sensitivity factor, $Y_{\delta\,rel\,T}$*~~

~~$Y_{\delta relT} = 1 + 0.036\,(q_s - 2{,}5)\left(1 - \frac{\sigma_Y}{1200}\right)$ for through hardened steels~~

~~$Y_{\delta\,rel\,T} = 1 + 0{,}008\,(q_s - 2{,}5)$ for carburised and induction hardened steels, and~~

~~$Y_{\delta\,rel\,T} = 1 + 0{,}04\,(q_s - 2{,}5)$ for nitrided steels.~~

3.5.6 Rim thickness factor, Y_B

Factor Y_B is to be determined as follows:

(a) For external gears

If $S_R/h \geq 1{,}2$ then $Y_B = 1$

If $0{,}5 < S_R/h < 1{,}2$ then $Y_B = 1{,}6 \cdot ln\left(2{,}242\frac{h}{s_R}\right)$

where

S_R = rim thickness of external gears, mm

The case $S_R/h \leq 0{,}5$ is to be avoided.

(b) For internal gears

If $S_R/m_n \geq 3{,}5$ then $Y_B = 1$

If $1{,}75 < S_R/m_n < 3{,}5$ then $Y_B = 1{,}15 \cdot ln\left(8{,}324\frac{m_n}{s_R}\right)$

where

S_R = rim thickness of internal gears, mm

The case $S_R/m_n \leq 1{,}75$ is to be avoided.

3.5.7 Deep tooth factor Y_{DT}

The deep tooth factor, Y_{DT}, adjusts the root stress to take into account high precision gears and contact ratios within the range of virtual contact ratio $2{,}05 \leq \varepsilon_{\alpha_n} \leq 2{,}05$ where:

$\varepsilon_{\alpha n} = \frac{\varepsilon_\alpha}{cos^2\beta_b}$

Factor Y_{DT} is to be determined from Table 5.3.9:

Table 5.3.9 Values of deep tooth factor, Y_{DT}

	Y_{DT}
ISO Accuracy Grade ≤ 4 and $\varepsilon_{\alpha_n} > 2{,}5$	0,7
ISO Accuracy Grade ≤ 4 and $2{,}05 < \varepsilon_{\alpha_n} \leq 2{,}5$	2,366 – 0,666·ε_{α_n}
In all other cases	1,0

3.5.8 Relative notch sensitivity factor, $Y_{\delta\,rel\,T}$

$Y_{\delta relT} = \frac{1 + \sqrt{0{,}2\rho'(1 + 2q_s)}}{1 + \sqrt{1{,}2\rho'}}$

ρ' = slip-layer thickness is to be taken from Table 5.3.10

Table 5.3.10 Slip-layer thickness, ρ'

Material		ρ', (mm)
Case-hardened steels, flame or induction-hardened steels		0,0030
Through-hardened steels, yield point R_e =	500 N/mm^2	0,0281
	600 N/mm^2	0,0194
	800 N/mm^2	0,0064
	1000 N/mm^2	0,0014
Nitrided steels		0,1005
Note: The given values of ρ' can be interpolated for values of R_e not stated above		

Existing paragraphs 3.5.7 *to* 3.5.9 *have been renumbered* 3.5.9 *to* 3.5.11.

3.6 Factors of safety

3.6.1 Factors of safety are shown in Table 5.3.~~4~~7.

Part 5, Chapter 6

Main Propulsion Shafting

Effective date 1 January 2015

■ *Section 3* Design

3.5 Screwshafts and tube shafts

(*Part only shown*)

3.5.1 The diameter, d_p of the screwshaft immediately forward of the forward face of the propeller boss or, if applicable, the forward face of the screwshaft flange, is to be not less than determined by the following formula:

$$d_p = 100k\sqrt[3]{\frac{P}{R}\left(\frac{560}{\sigma_U + 160}\right)}\ mm$$

$$\left(d_p = 90{,}5k\sqrt[3]{\frac{P}{R}\left(\frac{57}{\sigma_U + 16}\right)}\ mm\right)$$

where

k = 1,22 for a shaft carrying a keyless propeller fitted on a taper, or where the propeller is attached to an integral flange, and where the shaft is fitted with a continuous liner, a coating of an approved type, or is oil lubricated and provided with an approved type of oil sealing gland

= 1,26 for a shaft carrying a keyed propeller and where the shaft is fitted with a continuous liner, a coating of an approved type, or is oil lubricated and provided with an approved type of oil sealing gland

Part 5, Chapter 12

Piping Design Requirements

Effective date 1 January 2015

■ *Section 1*
General

1.2 Definitions

1.2.1 **Piping system** includes pipes and fittings such as expansion joints, valves, pipe joints, support arrangements, flexible tube lengths, etc., and components in direct connection with the piping such as pumps, heat exchangers, air receivers, independent tanks, etc.

Existing sub-Sections 1.2 *to* 1.6 *have been renumbered* 1.3 *to* 1.7.

■ *Section 2*
Carbon and low alloy steels

2.12 Other mechanical couplings

2.12.12 Mechanical joints are to be tested in accordance with ~~a program approved by LR~~ the test requirements of LR's *Type Approval Test Specification Number 2*, ~~which is to include the following tests~~ as relevant to the service conditions and the intended application. The programme of testing is to be agreed with LR. ~~:~~

- ~~leakage test;~~
- ~~vacuum test (where necessary);~~
- ~~vibration (fatigue) test;~~
- ~~fire endurance test (where necessary);~~
- ~~burst pressure test;~~
- ~~pressure pulsation test (where necessary);~~
- ~~assembly test (where necessary);~~
- ~~pull out test (where necessary);~~
- ~~static displacement/ misalignment test (where necessary).~~

■ *Section 9*
Piping for LPG/LNG carriers, gas fuelled ships and classed refrigeration systems

9.6 Valves for cryogenic temperature service

9.6.1 Each size and type of valve intended to be used at a working temperature below –55°C shall be approved. Approval is based upon prototype testing and assessment of the ~~through~~ design ~~appraisal~~ for compliance with a recognised national or international standard acceptable to LR ~~and prototype testing~~.

■ *Section 10*

Austenitic stainless steels

10.1 Pipe thickness

Table 12.10.1 Minimum thickness for austenitic stainless steel pipes

Standard pipe sizes (outside diameter) in mm	Min. thickness, in mm
8,0 to 10,0	0,8
10,2 to 17,2	1,0
21,3 to 48,3	1,6
60,3 to 88,9	2,0
114,3 to 168,3	2,3
219,1	2,6
273,0	2,9
323,9 to 406,4	3,6
over 406,4	4,0
NOTE Diameters and thicknesses according to national or international standards may be accepted.	

Part 5, Chapter 13

Ship Piping Systems

Effective date 1 January 2015

■ *Section 12*

Air, overflow and sounding pipe

12.7 Air pipe closing appliances

12.7.2 Air pipe closing devices are to be ~~of a~~ type ~~acceptable to Lloyd's Register (hereinafter referred to as 'LR') and are to be~~ tested in accordance with ~~a National or International Standard recognised by LR~~ the test requirements of LR's *Type Approval Test Specification Number 2*. The flow characteristic of the closing device is to be determined using water, *see* 12.8.1 and 12.8.2.

Part 5, Chapter 14

Machinery Piping Systems

Effective date 1 January 2015

■ *Section 3*

Oil fuel burning arrangements

3.11 Booster pumps when operating in emissions control areas

3.11.3 When the booster pumps which are fitted in compliance with 3.10 are suitable to operate on marine fuels with a sulphur content not exceeding 0,1 per cent m/m and minimum viscosity of 2 cSt, but one pump alone is not capable of delivering marine fuels with a sulphur content not exceeding 0,1 per cent m/m and minimum viscosity of 2 cSt at the required capacity, two booster pumps may operate in parallel to achieve the required capacity for normal operation of propulsion machinery. In this case, one additional (third) fuel oil pump is to be provided. The additional booster pump shall, when operating in parallel with one of the booster pumps in 3.10, be suitable for and capable of delivering marine fuels with a sulphur content not exceeding 0,1 per cent m/m and minimum viscosity of 2 cSt at the required capacity for normal operation of the propulsion machinery.

■ *Section 8*

Lubricating oil systems

8.8 Filling arrangements

~~*8.8.2* Provision is to be made against over-pressure in the filling pipelines, and any relief valve fitted for this purpose is to discharge to an overflow tank or other safe position, or an equivalent arrangement is to be provided, except filling by means of loose hose.~~

■ *Section 9*

Hydraulic systems

9.5 Filling arrangements

~~*9.5.2* Provision is to be made against over-pressure in the filling pipelines, and any relief valve fitted for this purpose is to discharge to an overflow tank or other safe position, or an equivalent arrangement is to be provided, except filling by means of loose hose.~~

Part 5, Chapter 25

Ballast Water Treatment System and Installation

Effective date 1 January 2015

Part 5, Chapter 13, Section 11.3 has been deleted in its entirety

■ *Section 1*

General

1.1 Purpose and scope

1.1.1 The purpose of this Chapter is to provide rule requirements for machinery and equipment used to prevent transfer of harmful aquatic organisms and pathogens within ballast water and sediment. Such machinery and associated equipment is hereinafter referred to as the Ballast Water Treatment System (BWTS).

1.1.2 The Rules are intended to ensure that the design, construction and installation of the BWTS achieve a level of safety which is acceptable to Lloyd's Register (LR) and, additionally, to ensure that a failure of the BWTS will not affect the operation of essential ship systems.

1.1.3 These requirements do not address the environmental performance of the BWTS, which is subject to the national and international statutory requirements. Operators are responsible for ensuring compliance with the relevant ballast water discharge standards and sediment controls.

1.1.4 Where risk-based studies identify further risk mitigation measures in addition to the specific requirements in the Rules then such measures are to be implemented.

1.2 Definitions

1.2.1 Where any of the terms contained within this Section are used within this Chapter, their meaning is to be as defined in 1.2.2 to 1.2.16.

1.2.2 **Area –** area means a defined location on board the ship. An area can be on open deck. An area can be open, semi-enclosed or enclosed. An area can be a space below deck. An area can be hazardous or non-hazardous.

1.2.3 **Ballast Water Treatment System –** is the arrangement in place for the purpose of treating ballast water, collecting samples, and analysing discharge (if fitted). It includes piping and fittings, equipment, treatment techniques and an electrical and control system.

1.2.4 **Concentrated treatment –** is the accumulation of treatment medium or its by-product (e.g. chemicals, other reactive materials, dissolved gases, etc.).

1.2.5 **Hazardous material –** a substance, in the form of liquid, solid or gaseous state, solely or in combination with other material, which promotes danger to environment or human life.

1.2.6 **Hazardous area –** as defined in Pt 6, Ch 2, 14.5.

1.2.7 **Reactive material –** a substance, used in ballast water treatment, which has potential for rapid oxidation or for undergoing a chemical reaction when in contact with other substances.

1.2.8 **Risk –** the combination of the likelihood of a potentially dangerous event and its consequence. Likelihood may be expressed as a probability or a frequency.

1.2.9 **Risk assessment –** is the evaluation of likelihood and consequence, together with a judgement on the significance of the result. *See* IEC/ISO 31010: *Risk management, risk assessment techniques*.

1.2.10 **Side stream piping arrangement –** is an arrangement in place to use a portion of ballast water from main ballast line or sea water from other sources (typically less than 10 per cent of ballast line capacity). The purpose for this arrangement is to produce a concentrated treatment (*see* 1.2.4) that is then applied to the rest of the ballast capacity.

1.2.11 **Accommodation spaces –** are those spaces used for public spaces, corridors, lavatories, cabins, offices, hospitals, cinemas, game and hobby rooms, barber shops, pantries containing no cooking appliances and similar spaces.

1.2.12 **Cargo area** – is that part of the ship that contains cargo holds, cargo tanks, slop tanks and cargo pump-rooms including pump-rooms, cofferdams, ballast and void spaces adjacent to cargo tanks and also deck areas throughout the entire length and breadth of the part of the ship over the above-mentioned spaces.

1.2.13 **Machinery spaces of category A** – are those spaces and trunks to such spaces which contain either:
(a) internal combustion machinery used for main propulsion;
(b) internal combustion machinery used for purposes other than main propulsion where such machinery has in the aggregate a total power output of not less than 375 kW; or
(c) any oil-fired boiler or oil fuel unit, or any oil-fired equipment other than boilers, such as inert gas generators, incinerators, etc.

1.2.14 **Other machinery spaces** – are spaces containing propulsion machinery, boilers, oil fuel units, steam and internal combustion engines, generators and major electrical machinery, oil filling stations, refrigerating, stabilizing, ventilation and air conditioning machinery, and similar spaces, and trunks to such spaces.

1.2.15 **Service spaces –** are those spaces used for galleys, pantries containing cooking appliances, lockers, mail and specie rooms, store rooms, workshops other than those forming part of the machinery spaces, and similar spaces and trunks to such spaces.

1.2.16 **Special category spaces –** are those enclosed vehicle spaces above and below the bulkhead deck, into and from which vehicles can be driven and to which passengers have access. Special category spaces may be accommodated on more than one deck provided that the total overall clear height for vehicles does not exceed 10 m.

■ *Section 2*
Functional requirements

2.1 General

2.1.1 Failure of the Ballast Water Treatment System (BWTS) is not to impair or restrict ballasting or de-ballasting operations.

2.1.2 Failure of the BWTS is not to impair essential systems as defined by, but not limited to, Pt 6, Ch 2, 1.6.

2.1.3 The BWTS is not to present a hazard to the personnel, the ship or the environment during normal operation or in the event of foreseeable failure.

■ *Section 3*
Performance requirements

3.1 General

3.1.1 The Ballast Water Treatment System is to be able to treat the ballast capacity of the vessel. Where specific requirements or conditions are to be maintained for the effectiveness of BWTS, the safety of the ship is not to be compromised.

3.1.2 Ballast water system pressure drop due to the BWTS is to be compensated, as required, to ensure that operation of the ballast water system is not compromised.

3.1.3 Where the BWTS, or its associated equipment, is in use for purposes other than that required by 1.1.1, means should be provided to ensure that the BWTS is readily available for the primary purpose of treating ballast water.

3.1.4 The BWTS arrangement, including treatment units, filtration units, electrical and control units, sampling arrangements, neutralising units with associated piping and fittings, structural arrangements and hazardous area classification, where applicable, shall be subjected to appraisal and be acceptable to LR.

3.1.5 By-pass and isolation arrangements are to be provided for BWTS as required in 11.3.

3.1.6 The design of BWTS equipment is to minimise the risk of fire, overheating, explosion and asphyxiation hazards arising from the use and/or production of chemicals and other substances. *See* 9.1.6.

3.1.7 The build-up of hazardous material in ballast pipes and in ballast tanks is to be prevented.

3.1.8 Ballast tank coatings are not to be affected by the prolonged exposure to any hazardous materials that may be released into the ballast water.

■ *Section 4*
Documentation required for appraisal

4.1 Ballast Water Treatment System appraisals

4.1.1 The documents listed in 4.1.2 to 4.1.9 are to be submitted for appraisal of the ballast water treatment system (BWTS).

4.1.2 A description of the BWTS and the treatment technique(s) used. This is to include the proposed treatment unit configurations, method of integration with the ship's ballast system and specific requirements for ancillary systems.

4.1.3 Functional description of the BWTS including the system operational concept and system description details.

4.1.4 Process Flow Diagram (PFD) of the BWTS.

4.1.5 Material specification for all items used in the construction of the BWTS including temperature and pressure ratings.

4.1.6 Details of flammability, toxicity and reactivity of chemicals to be made available along with the instructions for storage, handling and fire-fighting.

4.1.7 Arrangement plans and circuit diagrams of the switchboards and line diagrams of any control and safety system(s) fitted.

4.1.8 Report of risk-based studies, *see* Section 6.2.

4.1.9 Documents, plans and information, as listed in the following Rules, are to be submitted:

(a) For control systems:
  (i) Details of control, alarm and safety systems as required by Pt 6, Ch 1,1.2.2
  (ii) Details of programmable electronic systems as required by Pt 6, Ch 1,1.2.5
  (iii) Plans showing the details and location of control stations as required by Pt 6, Ch 1,1.2.7
  (iv) Details of instrumentation and control cabling as required by Pt 6, Ch 1,1.2.9

(b) For BWTS which are to be installed in hazardous areas:
  (i) Details, plans and arrangements required by Pt 6, Ch 2, 14
  (ii) A schedule of equipment for use in explosive atmospheres as required by Pt 6, Ch 2, 1.2.9

(c) Type Approval Certification where required by the LR Rules, *see* Pt 6, Ch 1,2.

4.2 Ballast Water Treatment System ship specific installation appraisal

4.2.1 The documents listed in 4.2.2 to 4.2.11 are to be submitted for appraisal of the installation of a ballast water treatment system (BWTS) on board an LR classed ship*,* in addition to details of the BWTS required by 4.1.3, 4.1.6 and 4.1.9.

4.2.2 Piping and Instrumentation Diagram (P&ID) of the ballast system, showing the proposed integration with the BWTS and ancillary systems connected to the BWTS, including cross-connections.

4.2.3 For retrofit installations, in addition to 4.2.2, existing ballast system's P&IDs are to be submitted along with details of any modifications required, such as cross-connection, tank construction, air vent, overflow lines, hull penetration, etc.

4.2.4 Material specification, temperature and pressure ratings of piping, valves and fittings used to integrate treatment unit(s) and associated equipment into the ballast system.

4.2.5 Details of by-pass arrangement or, where a by-pass arrangement is not fitted, evidence demonstrating the ability of the ship's ballast system to continue in operation at full capacity regardless of the BWTS's condition.

4.2.6 General arrangement of the ship showing layout of the BWTS installation, including major items of electrical equipment.

4.2.7 A copy of the risk-based study report conducted for the BWTS, *see* 4.1.8.

4.2.8 Schedule of mechanical equipment to be located in hazardous area.

4.2.9 Details of electrical equipment and hazardous area installation as listed in the following Rules respectively:
(a) Details and arrangements of electrical equipment required by Pt 6, Ch 2,1.2.2 (a), (b), (d), (e), (f) and (g)
(b) Details of the location and arrangement of hazardous area zones as required by Pt 6, Ch 2,1.2.8.

4.2.10 Fire detection, extinction and suppression arrangements of compartment(s) where the BWTS and associated chemicals are stored/in use, as applicable. This is to include specific extinguishing requirements and compatibility with materials/chemicals used.

4.2.11 In addition to the above, for a BWTS meant to be installed in tankers or a BWTS which generates or uses hazardous material, the following plans are required to be submitted:
(a) Ventilation system plans, including airlocks, pipe penetrations and general construction details, if the BWTS is meant to be placed in a dedicated room, *see* 10.4. The ship's plans are to indicate hazardous area configuration, if any.
(b) Plans for ventilation system and electrical and mechanical equipment ratings are to be submitted if the BWTS is meant to be placed in the cargo pump room.
(c) A water tightness test report is to be submitted for the equipment which is to be used in a submerged or semi-submerged condition.

■ *Section 5*
Materials

5.1 General

5.1.1 Material used for the Ballast Water Treatment System (BWTS) is to be manufactured and tested in accordance with the requirement of the *Rules for the Manufacture, Testing and Certification of Materials*.

5.1.2 Where the BWTS uses hazardous or reactive materials then the proposed materials for construction are to be suitable for their intended use. Such materials are subject to special consideration and are to be considered in the risk-based studies, *see* Section 6.

5.1.3 Materials for construction of chemical storage tanks and associated piping systems are to be in accordance with the *Rules and Regulations for the Construction and Classification of Ships for the Carriage of Liquid Chemicals in Bulk* (hereinafter referred to as the Rules for Ships for Liquid Chemicals), as applicable.

■ *Section 6*
Risk-based studies

6.1 Purpose

6.1.1 The purpose of the risk-based studies is to:
(a) Evaluate the safety of the BWTS.
(b) Evaluate the safety of the integration of the BWTS with the ballast system and other ship's systems.
(c) Specially consider system designs which deviate from the requirements of LR Rules.

6.1.2 The risk-based studies are to be undertaken in accordance with LR's ShipRight procedure, *Assessment of Risk Based Design* and associated annexes.

6.1.3 The risk-based studies are to be undertaken to an acceptable industry or international standard (e.g. ISO 31010 *Risk management – Risk assessment techniques*), *see* 6.2.1.

6.1.4 Risk-based studies for ship specific installation are required (*see* 6.3),
(a) if the system arrangement deviates from the requirements for installation of this Chapter, or
(b) if the Risk assessment of the BWTS, *see* 6.2, identifies a need for further studies at the installation phase.

6.2 Risk assessment of BWTS

6.2.1 The risk assessment is to identify the hazards associated with operation and maintenance of the BWTS under all normal and reasonably foreseeable abnormal conditions including but not limited to system integrity, leakage scenarios and accumulation of hazardous materials.

6.2.2 The risk assessment is to consider any risk of scaling the BWTS to suit the different treatment capacities. It is to consider, but not be limited to, the effects of treatment techniques, by-products and neutralisation methods, as applicable.

6.2.3 The risk assessment is to consider risks, in general, which may occur when integrating the BWTS into the ship's ballast water system and associated systems as outlined in *6.3.2.*

6.2.4 The risk assessment is to demonstrate that an appropriate level of safety is achieved; the risk acceptability criteria are to be defined by the risk-based study and are to be acceptable to LR.

6.2.5 A risk assessment may identify further safety measures in addition to those specifically stated in the Rules.

6.3 Risk assessment of BWTS installation

6.3.1 The risk assessment is to identify hazards associated with operation and maintenance of the BWTS in a ship specific environment, under all normal and reasonably foreseeable abnormal conditions. *See* 6.2.1, 6.2.2 and 6.2.3.

6.3.2 The risk assessment is to focus on, but not be limited to, risks which may affect safety of persons and the reliable operation of essential ship systems associated with operation of the BWTS under all normal and abnormal conditions. As a minimum the following are to be considered:

- effects on ballast tank coatings;
- effects on existing piping, fittings and valves;
- hazardous area classification;
- structural strength and integrity of hull;
- fail-safe condition, location and arrangement of isolation valves;
- accumulation of flammable or toxic gases;
- storage and handling of chemicals or reactive materials.

6.3.3 The risk assessment is to demonstrate that an appropriate level of safety is achieved and that the reliability of essential services is improved or remains unchanged. For risk acceptability criteria, *see* 6.2.4.

6.3.4 The risk assessment may identify further safety measures in addition to those specifically stated in the Rules.

6.4 Assessment of alternative BWTS designs

6.4.1 Alternative BWTS designs which deviate from these Rules are subject to special consideration and may be accepted by LR where supported by a risk assessment which demonstrates an equivalent level of safety to that which would be achieved by application of these Rules.

6.4.2 The risk assessment is to include an analysis of the BWTS as indicated in 6.2 and 6.3, as applicable.

6.4.3 The risk assessment may identify the requirement for safety measures in addition to those specifically stated in the Rules.

■ *Section 7*
Piping systems

7.1 General

7.1.1 Manufacturing, testing and integration of piping and fittings are to be in accordance with the *Rules and Regulations for the Classification of Ships* (hereinafter referred to as the Rules for Ships), Pt 5, Ch 12, 13, 14 and 15.

7.1.2 Piping systems which carry chemical substances are to meet the requirements of Ch 5 of the Rules for Ships for Liquid Chemicals. Use of non-metallic materials will require special consideration.

7.1.3 Piping systems which carry sea water or fresh water are to meet the requirements as per 7.1.1. Where there is a risk of a water system becoming contaminated with hazardous materials (e.g. process chemicals, reactive materials or by-products), piping systems are to comply with 7.1.2 as applicable.

7.1.4 Piping systems utilising plastic pipes are to meet the requirements of Table 12.5.3 in Ch 12.

7.1.5 Piping systems utilised for handling active/reactive materials are to be separate and distinct from each other and the ship's piping systems.

7.2 Side stream piping

7.2.1 Side stream piping is to meet the requirements of 7.1 and the piping which carries concentrated treatment is also to meet the requirements of 7.2.2 to 7.2.4.

7.2.2 Material for side stream piping is to be non-reactive with the water properties and substances used in the system.

7.2.3 Side stream piping is to be designed to minimise pipe length and number of connections. Alternatively it is to be demonstrated that risk of leakage is limited and the formation of toxic or flammable atmosphere is prevented.

7.2.4 Side stream piping is to be protected against mechanical damage.

■ *Section 8*
Mechanical equipment and components

8.1 General

8.1.1 Air, sounding and overflow arrangement associated with BWTS are to comply with the requirement of Pt 5, Ch 13, 11 and 12 respectively.

8.1.2 Modification to ballast tank, air and overflow system, air pipe closing appliances and other systems and equipment is subject to special approval, *see* Section 10.

8.1.3 Chemical injection lines, concentrated treatment injection lines, inert gas injection lines and sampling point are to be of a rigid construction and be properly supported.

8.1.4 De-gassing equipment is to demonstrate that the risk of leakage is prevented. Vent arrangements are to be directed to a safe location on open deck. A safe location is a location that in the absence of a vent would be non-hazardous. Hazardous area classification is to be conducted for the area surrounding the openings of such vents.

8.2 Filtering units

8.2.1 Filters to be sized to the maximum flow rate of the ballast system.

8.2.2 Filters arranged in line with the ballast system are to be provided with redundancy.

8.2.3 Filter casings are to satisfy the requirements of Pt 5, Ch 11, as applicable, *see* also 5.1.1.

8.2.4 Where filters are provided with by-pass arrangement as per 11.3, above requirements 8.2.2 and 8.2.3 may be exempted.

8.3 Other components

8.3.1 Inert gas systems are to meet the technical requirements of Pt 5, Ch 15, 7, as applicable.

8.3.2 Ozone generators, electro chlorination units, electrolysis units, oxygen generators, electrodialytic units, ultraviolet units, ultrasonic units, coagulation units, other treatment units and ancillaries are to be constructed to recognised industrial, National or International Standards acceptable to LR.

■ *Section 9*
Electrotechnical Systems

9.1 General

9.1.1 Control, ALERT and SAFETY systems are to be in accordance with the requirements of Pt 6, Ch 1.

9.1.2 Electrical engineering systems are to be in accordance with the requirements of Pt 6, Ch 2.

9.1.3 A gas detection system with audible and visual alarm is to be provided for spaces, containing BWT equipment, which may present a hazardous atmosphere. The alarm is also to be provided on the bridge, at manned ballast water control station(s) and in the

engine control room, as applicable. BWTS shutdown is to be activated at a concentration of not more than 40 per cent of Lower Explosive Limit (LEL).

9.1.4 Gas detection equipment is to be designed, installed and tested in accordance with IEC 60079-29-1 *Explosive atmospheres – Part 29-1: Gas detectors – Performance requirements of detectors for flammable gases*, and is to be suitable for the gases to be detected.

9.1.5 Failure of a BWTS power or control system is not to render the BWTS hazardous and is not to affect the operation of essential systems.

9.1.6 Active or passive monitoring systems with alarm and safeguards are to be provided to mitigate risks and to ensure the safety of the ship and its occupants.

■ *Section 10*
Structural and space categorisation requirements

10.1 Structural requirements

10.1.1 The structural requirements are to comply with the relevant LR Rules and statutory requirements as applicable and separately approved. Consideration is to be given to BWTS space boundaries, fire integrity, hull penetrations and chemical storage tank constructions, if fitted.

10.2 Ballast tanks requirements

10.2.1 Tanks which could be subjected to over- or under-pressure are to be fitted with Pressure-Vacuum valves and a means of pressure measurement. Deviation from normal working pressure is to activate an alarm and is to shut down the BWTS. The pressure at which shutdown is to occur is to be set in accordance with the tank manufacturer's recommendations.

10.3 Chemical storage tank requirements

10.3.1 A means of controlling overflow is to be provided for the chemical storage tanks. Arrangements are to comply with the Rules for Ships for Liquid Chemicals, 8.2.3, LR 8.2 (a) and 15.19.

10.3.2 Tanks for chemicals which react in a hazardous manner with other chemicals, residues or mixtures, are to:
(a) be segregated from such other tanks by means of a cofferdam, void space, cargo pump-room, pump-room, empty tank, or tank containing a mutually compatible chemical;
(b) have separate pumping and piping systems which shall not pass through other tanks containing such chemicals, unless encased in a tunnel;
(c) have separate tank venting systems.

10.3.3 The tank and associated gauging requirements indicated in the IBC Code, Ch 17, columns (f), (g), (h) and (j) are to be complied with, as applicable to the chemicals being carried.

10.3.4 Secondary containment is to be provided for all free standing chemical storage tanks. Special consideration is to be given to storage tanks situated in high fire risk areas such as machinery spaces of category A.

10.4 BWTS space categorisation requirements

10.4.1 BWTS location, and ventilation requirements for spaces containing BWTS are to be in accordance with the requirements of Table 25.10.1.

Table 25.10.1 Space categorisation and installation requirements

	BWTS which generates or uses hazardous material (i.e. Electro chlorination, chemical injection, ozone, etc.). *See* Note 3	BWTS which does not generate or use hazardous material (UV reactor, ultra sound, mechanical filtration)
Machinery space of category A	Fitted with mechanical ventilation providing at least six (6) air changes per hour	Provide with adequate ventilation
Other machinery spaces		
Accommodation space	Not allowed to install	Not allowed to install
Cargo area, *see* Note 2	Fitted with mechanical ventilation providing at least six (6) air changes per hour	Provide with adequate ventilation
Weather deck, *see* Note 2		
Service spaces, *see* Note 2	Not allowed to install, *see* Note 1	Not allowed to install, *see* Note 1
Special category space, *see* Note 2		

NOTES

1. May be allowed to install subjected to special consideration, *see* 6.3.
2. Installation space in hazardous area is to be fitted with mechanical ventilation system providing at least twenty (20) air changes per hour or as complying with relevant requirements, i.e. IEC60092-502, IBC code, IGC code, etc., whichever is greater.
3. For BWTS using ozone generators or electro chlorination with de-gas equipment, six (6) are to be replaced with twenty (20) air changes per hour. BWTS shutdown is to be activated upon failure of the ventilation system.

10.4.2 For BWTS which generates or uses hazardous materials, the following mitigation measures of 10.4.3 to 10.4.6 are to be complied with, as applicable.

10.4.3 Where failure of the BWTS may result in release of hazardous material (e.g. toxic, flammable, etc.), gas detection is to be provided. The BWTS is to be shut down on detection of a gas concentration that is recognised as hazardous, *see* 9.1.3.

10.4.4 For the location of audible and visual alarms, *see* 9.1.3.

10.4.5 Vent arrangement is to be provided to discharge hazardous gas to a safe location on open deck in the event of failure of the BWTS as in 10.4.3.

10.4.6 Where failure of the BWTS may result in release of hazardous material of flammable nature, electrical equipment is to comply with the requirements of Pt 6, Ch 2.14.

■ *Section 11*
System arrangement requirements

11.1 General

11.1.1 The BWTS arrangement is to satisfy the requirements of this Section as applicable.

11.2 Installation requirements

11.2.1 BWTS are to be installed to ensure that the treatment system can be efficiently isolated from the ballast water system without impairing ballast water flow.

11.2.2 Transfer of ballast between gas-safe areas and ballast tanks immediately adjacent to cargo tanks which carry either flammable liquids of a flash point not exceeding 60 degrees or liquefied chemicals in bulk is not permitted, unless otherwise stated in this Section. Ballast arrangements on ships carrying liquefied gases in bulk will be subject to special consideration.

11.2.3 Gas-safe areas are not to be rendered hazardous by the use of the BWTS or the connection with the ballast system as indicated above, *see* 11.2.2.

11.3 By-pass and isolation arrangement

11.3.1 The BWTS is to be provided with isolation valves to effectively isolate it from any essential ship systems to which it is connected.

11.3.2 By-pass valves, if fitted, *see* 4.2.5, are to be accompanied by isolation valves to effectively by-pass and isolate the system.

11.3.3 By-pass and isolation valves are to be provided with remote means of operation and are also to comply with the requirements of Pt 5, Ch 12, 6.1.3 and 6.1.4 and Ch 13, 2.3.

11.3.4 Failure of power or control systems is not to impair or restrict the by-pass or isolation arrangements or alternatively is to be demonstrating that the fail safe arrangement is in place to ensure the function of by-pass and isolation arrangements.

11.3.5 By-pass and isolation valves are to be provided with position indicators to give remote indication of valve position.

11.3.6 Activation of by-pass or isolation arrangements is to activate an alarm in all stations from which the ballast water operations are controlled and on the navigating bridge.

11.3.7 Isolation and by-pass valves are to be placed in easily accessible positions.

11.4 Ballast arrangement between hazardous and non-hazardous area

11.4.1 Conditions for BWTS connecting with ballast water serving hazardous and non-hazardous areas are to meet the requirements of 11.4.2 to 11.4.6.

11.4.2 Ballast water discharge from tanks within the hazardous area is not to be connected with the ballast piping serving in the non-hazardous area.

11.4.3 Ballast water for sampling/analysing may be allowed into non-hazardous areas, provided that sampling or analysing systems meet the requirements of 11.4.6.

11.4.4 Ballast water piping serving non-hazardous areas may be used to fill the ballast tanks in hazardous areas, provided that two non-return valves are installed in series. One of them is to be of a screw-down non-return type.

11.4.5 All pipe penetrations from the non-hazardous area to the hazardous area are to be led above main deck level.

11.4.6 Conditions for transferring ballast water from hazardous areas to non-hazardous areas, for the purpose of sampling/analysing, are to comply with the requirements of 11.4.7 to11.4.13, as minimum.

11.4.7 The sampling/analysing unit is to be located within a gas-tight enclosure and provided with mechanical ventilation. Exhaust is to be led to a safe area on the ship.

11.4.8 A remotely-operated stop valve is to be installed in the cabinet for each sample pipe.

11.4.9 A gas detection device is to be installed in the cabinet as per 9.1.4 and, upon detection, an audible and visual alarm is to be activated at the relevant control station and the above stop valve is to be automatically closed.

11.4.10 Audible and visual alarms are to be connected to the control system and activated upon detection of an explosive gas concentration, i.e. not more than 40 per cent of the Lower Explosive Level (LEL) or upon failure of the mechanical ventilation system.

11.4.11 Pipes are to be of steel or equivalent. Alternative material is subject to special approval. It should also meet the requirements of 7.2.

11.4.12 The return pipe is to be provided with a non-return valve to prevent reverse flow.

11.4.13 The suction and return pipes are to be provided with stop valves close to the penetration of the bulkhead at the gas safe side.

■ *Section 12*
Fire safety requirements

12.1 General

12.1.1 Spaces containing BWTS are to be provided with fixed fire detection and fire alarm systems complying with the International Code for Fire Safety Systems. As a minimum, the following spaces are to be covered:

- chemical storage spaces;
- treatment unit spaces;
- electrical equipment spaces;
- other spaces, if identified in Section 6 *Risk-based studies.*

12.1.2 Fire suppression techniques and medium are to be compatible with the chemicals and gases associated with the BWTS installed. Material Safety Data Sheets (MSDS) should be available and prominently displayed for all chemicals and gases employed in the ballast treatment process.

Part 7, Chapter 3

Fire-fighting Ships

Effective date 1 January 2015

■ *Section 3*
Fire-extinguishing

3.2 Pumps

3.2.1 The pumps and their piping system which are intended for serving the monitors are not to be available for services other than fire-extinguishing and water spraying. ~~They are~~ Each pump is to be provided with a dedicated independent sea ~~inlets~~ chest.

Section numbering in brackets reflects any Section renumbering necessitated by any of the Notices that update the current version of the Rules for Ships.

Part 1, Chapter 2

3.8.14 now *3.9.14* Reference to Part 1, Chapter 2,3.8.4 *now reads* Part 1, Chapter 2, 3.9.4

Part 5, Chapter 12

1.2.1 now *1.3.1* Reference to Part 5, Chapter 12,1.2.2 *now reads* Part 5, Chapter 12, 1.3.2

1.2.1 now *1.3.1* Reference to Part 5, Chapter 12,1.2.3 *now reads* Part 5, Chapter 12, 1.3.3

1.2.1 now *1.3.1* Reference to Part 5, Chapter 12,1.2.4 *now reads* Part 5, Chapter 12, 1.3.4

1.2.1 now *1.3.1* Reference to Part 5, Chapter 12,1.3 *now reads* Part 5, Chapter 12, 1.4

1.2.1 now *1.3.1* Reference to Part 5, Chapter 12,1.4 *now reads* Part 5, Chapter 12, 1.5

2.1.1 Reference to Part 5, Chapter 12,1.6 *now reads* Part 5, Chapter 12, 1.7

2.2.3 Reference to Part 5, Chapter 12,1.2.1 *now reads* Part 5, Chapter 12, 1.3.1

2.2.4 Reference to Part 5, Chapter 12,1.2.1 *now reads* Part 5, Chapter 12, 1.3.1

2.9.8 Reference to Part 5, Chapter 12,1.2.1 *now reads* Part 5, Chapter 12, 1.3.1

3.1.1 Reference to Part 5, Chapter 12,1.6 *now reads* Part 5, Chapter 12, 1.7

3.1.6 Reference to Part 5, Chapter 12,1.2.1 *now reads* Part 5, Chapter 12, 1.3.1

3.1.7 Reference to Part 5, Chapter 12,1.2.1 *now reads* Part 5, Chapter 12, 1.3.1

4.1.4 Reference to Part 5, Chapter 12,1.6 *now reads* Part 5, Chapter 12, 1.7

8.1.4 (a) Reference to Part 5, Chapter 12, 1.3 *now reads* Part 5, Chapter 12, 1.4

8.1.4 (b) Reference to Part 5, Chapter 12,1.2.1 *now reads* Part 5, Chapter 12, 1.3.1

16.4.2 Reference to Part 5, Chapter 12,1.3.1 *now reads* Part 5, Chapter 12, 1.4.1

Update to the current version of the Rules and Regulations for the Classification of Ships for Service on the Great Lakes and River St. Lawrence:

Part 1, Chapter 2

2.5.1 Reference to Part 1, Chapter 2,3.6.1 *now reads* Part 1, Chapter 2, 3.7.1

2.5.1 Reference to Part 1, Chapter 2,3.6.2 *now reads* Part 1, Chapter 2, 3.7.2

2.5.1 Reference to Part 1, Chapter 2,3.6.3 *now reads* Part 1, Chapter 2, 3.7.3

2.7.7 Reference to Part 1, Chapter 2,3.8.7 *now reads* Part 1, Chapter 2, 3.9.7

2.7.7 Reference to Part 1, Chapter 2,3.8.8 *now reads* Part 1, Chapter 2, 3.9.8

2.7.7 Reference to Part 1, Chapter 2,3.8.9 *now reads* Part 1, Chapter 2, 3.9.9

2.7.7 Reference to Part 1, Chapter 2,3.8.11 *now reads* Part 1, Chapter 2, 3.9.11

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